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Cerebral Dynamics and Discrete Energy Changes in the Personal Physical Environment During Intuitive-Like States and Perceptions

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ABSTRACT

The attribution of unobservable cognitive states to others, a component of the "Theory of Mind", involves activity within the right temporoparietal region. We tested an exceptional subject, Sean Harribance, who displayed a reliable, consistent configuration of QEEG activity over this region that was confirmed through source localization software. The blind-rated accuracies of the histories of 40 people shown in 40 different photographs were strongly correlated with the quantitative occurrence of this conspicuous QEEG pattern displayed during Mr. Harribance's "intuitive state". The proportions of specific microstates were also strongly correlated with his accuracy of discerning the historical characteristics of the people in the photographs. Compared to the normal population his microstates were half the duration and his sense of "now" was about twice as fast as the average person. During his intuitive states there was strong congruence of activity between the left temporal lobes of participants who sat near Mr. Harribance and the activity over his temporal (primarily right) lobes within the theta and 19-20 Hz band. Reversible increases in photon emissions and small alterations in the intensity within the nearby (up to a 1 meter) geomagnetic field along the right side of his head were equivalent to energies of about 10^{-11} Joules with amplitude modulations in the 0.2 to 0.6 Hz range. The results indicate even exceptional skills previously attributed to aberrant sources are variations of normal cerebral dynamics associated with intuition and may involve small but discrete changes in proximal energy.

Key words: Theory of Mind; microstates; temporoparietal region; geomagnetic alterations; photon emissions; intuitive states.

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1. Introduction

A fundamental human ability to predict and to interpret the behavior of others can be explained by a "Theory of Mind" (Happe 2003; Saxe and Wexler 2005). This is a process by which most healthy adults attribute unobservable cognitive states to others and integrate these states into a coherent model (Saxe and Wexler 2003; Vogeley 2001). Regions near the temporoparietal junction of the human brain have been implicated in a broad range of social cognitive tasks including recognition of faces and inferences about other's thoughts (Allison et al. 2000; Brunet et al. 2000; Fletcher et al. 1995; Hoffman and Haxby 2000).

Sean Harribance (SH) is a classic example of a person who possesses an ability to infer lifetime "experiences" of the putative memories of others while viewing photographs of a person or individuals known to this person while the latter is present. Most of his comments concerning the person are considered so exceptional, specific, or unique that his primary income for the last 40 years has been derived from these interpretations. His interpersonal behaviors are amicable and sincere but exhibit qualitatively different features that are clearly discernable by most people.

There has also been a long experimental and anecdotal history concerning SH and his capacity to "access" accurate information about others by mechanisms not known to date (Harribance 1994). Single photon emission computerized tomography (SPECT) displayed increased uptake of tracer and perfusion within the superior medial portion of the right parietal cortices during these experiences (Roll et al. 2002). Neuropsychological evidence suggested anomalous function within the frontoparietal-temporal region of the right hemisphere (Roll et al. 2002). During a previous visit (ten years ago) three different people, who were each given 10 pictures of their relatives and 10 comments (total of 30 photographs and 30 comments) by SH of the medical history and personal experiences of those people, correctly matched 8 out of 10 of the pictures with the descriptions.

By applying the modern tools of quantitative electroencephalography (QEEG) we found reliable signatures involving his right temporoparietal region that were associated with the ratings of accuracy for his statements. We also found consistent changes in QEEG activity within the right temporoparietal regions of the participants sitting near SH while he was "interpreting" the person or related photographs. We called this conspicuous, stable pattern the Harribance Configuration (HC). The overall pattern of activity and his subjective attributions suggested his experiences may be a variant of normal intuition (Kuo et al. 2009).

We have assumed that SH's unique ability to interpret such specific details of a person's life with no prior contact is primarily cerebrally generated and can be quantified by electroencephalography. On the bases of the proximity apparently required between SH and the person and the experienced physical changes reported by participants, we reasoned that the "information" might be obtained through a medium within the proximal environment. We hypothesized that two potential mediums may be a contributor to the reception of information: 1) biophoton emissions and 2) the shared geomagnetic field within which both SH and the subjects are immersed.

Biophotons have been shown to be potential neural communication signals (Sun et al, 2010).

According to Popp (1979) biological systems have the capacity to store coherent photons from the external world and emit a few hundred to about a thousand photons per cm^2 per second; he also hypothesized that photons may be utilized for cell-cell communication. The recent measurements that a photon is not massless (Liang-Cheng et al, 2005) have far reaching implications relevant to biological systems. They include deviations in the behaviour of static electromagnetic fields, longitudinal electromagnetic radiation and even questions of gravitational deflection (Liang-Cheng et al, 2005). Such small changes are even more important in light of the minute energies of about 10^{-20} J associated with an action potential (Persinger et al. 2008; Persinger, 2010) and the recent direct measurements that a single neuron can affect specific responses (Houweling and Brecht, 2008).

Biological systems emerged within the earth's magnetic field and human beings are immersed in the geomagnetic field. Fluctuations with peak-to-peak amplitudes of about 1% of the steady-state condition within the biofrequency to mHz range (Persinger, 1980) have powerful effects upon electroencephalographic activity (Babayev and Allahverdiyeva, 2007; Mulligan et al, 2010) and correlative behaviours that can be simulated experimentally (Michon and Persinger, 1997). That information could be stored within the space occupied by the earth's magnetic field has both theoretical and quantitative support (Persinger, 2009) although the definitive experiment to relate byte-dependent patterns to specific responses or ideas has not been completed. There is ample evidence that application of weak (microTesla to nanoTesla) physiologically-patterned magnetic fields, particularly over the right hemisphere, are associated with the report of common themes of experiences in normal volunteers (St-Pierre and Persinger, 2006, Persinger and Tiller 2008, Persinger et al. 2009).

2. Materials and Methods

2.1. Participants

All subjects who took part in this study did so with written informed consent. The procedures outlined were approved by Laurentian University's Research Ethics Board. Demographic information is given below with respect to each of the different paradigms. All testing was completed between 12:00-17:00 local time.

2.2. Data Acquisition and Analysis

2.2.1. Quantitative Electroencephalography (QEEG)

During his visit to our laboratory we measured SH over a period of five successive days, resulting in approximately 5 hours (500 to 1000 samples per sec) of QEEG measurements (8 or 19 channels) by different devices. Eight channels for F7, F8, T3, T4, P3, P4, O1, O2 from either of two Grass Instrument Model 8-16 C EEGs (16 channel) were monitored by hardcopy (paper). The filter selections for each channel were set for the standard range between 0.5 Hz and 35 Hz. Each Model 8-16C machine was interfaced via a custom shielded cable, a parallel analogue shield interface cable (Nat. Inst. SH100100) and a shielded connector block (Nat. Inst. SCB-100) to a National

Instruments PCI-607IE Multi I/O Board computer interface card. The data were extracted at 1000 Hz sampling (every 1 msec) by a DELL Dimension 8100 Personal Computer on a Windows 2000 Professional Platform. A custom designed user interface or Virtual Instrument (VI) using National Instruments Labview (Version 6.0i-2000) allowed the multichannel sample to be manually recorded to fixed disk.

A second QEEG utilized was a Mitsar 201 system amplifier which samples at 500 Hz with an input range of -500 to +500 microvolts and 16 bit analogue to digital conversion. The electrode cap (Electro-Cap International) utilized 19 AgCl electrodes using the 10-20 international standard method of electrode placement. Impedance for all electrodes was maintained at less than 10 kOhms. All electrodes were linked to ear references for monopolar measurements and appropriate channels for occasional bipolar recordings. WINEEG v2.82 was utilized for data collection, artifact removal, and spectral analyses. Visual inspection and independent component analysis were utilized for removal of all artifacts. Spectral analyses were computed utilizing WINEEG software and further statistical analysis of spectral components was completed using SPSS software. All EEG coherence results were completed utilizing EEG Lab software (Delorme and Makeig 2004).

Source localization was completed using sLORETA (standardized low resolution electromagnetic tomography; Jurcak et al. 2007; Pascual-Marqui 2002) software. sLORETA has cross-modal validation with respect to Brodmann area mapping with as few as 19 channels (Winterer et al. 2001, Mulert et al. 2004). Source localization analysis was utilized to assess how SH differed spectrally between his resting and IS (“interpretational state”) conditions. The IS condition was completed without talking while he was “calling his angel”. Four 1 minute sessions of IS were completed while wearing the 19 channel EEG from which eight 30 second artifact free EEG records were collected and compared with eight 30 second artifact free resting EEG sections.

2.2.2. Rated Accuracy of Types of Interpretations and EEG Patterns

The procedures preferred by SH were followed. EEG measurements were completed before, during, and after SH engaged in his “reading of another” which we called the “interpretational state” (IS) because of the unique pattern of EEG activity (HC). To discern if the HC was quantitatively associated with SH’s rated accuracy, 10 photographs of related individuals (children, niece, grandparents etc.) were supplied by 4 different people (Male, N=4, mean age = 24.5 SD = 1.12) who were not present at the time of the experiment but whom he had met previously. During the interpretations his comments were recorded by audiotape and his QEEG was continuously measured. SH was given each photograph by one of two people sitting with him in an acoustic chamber (the other person monitored the portable EEG measurements).

When his comments were finished the photograph was removed and another one was handed to SH. He would look at the photograph of the person for about 2-3 s and then begin with a series of brief descriptors concerning health, education, friendship patterns, death in the family, history of diseases, and general “personality”. The proportions of approximately 10 to 15 comments (each comment about 2 s) made for each of the 10 pictures from each person (n=40 photographs) were scored for specific accuracy by each of the four people separately a week later when the comments had been transcribed. The categories for the statements by SH were rated as false, generally true,

specifically true, future references, and “don’t know” or “unable to confirm”. A relative score for each picture was computed by calculating the ratio of true (sum of generally and specifically true) to the total of false plus true. A second proportional score was computed by calculating the number of true statements divided by the total number of comments for each picture. These scores were correlated with the total duration and number of HCs per picture. Factor analyses (varimax rotation) were completed utilizing the two dependent measures. Multiple regression analyses were also completed for these two dependent variables as a function of the various EEG spectral power measures. As a control for movement and muscle artifacts we instructed SH to complete his reading or “call his angel” in the same manner that he would when interpreting someone’s photograph.

2.2.3. Microstate and Accuracy Correlations

Research by Koenig et al (2002) has revealed consistent microstates whose durations are within the range of a percept, approximately 80 to 120 msec. The microstates are defined as periods of quasi-stable topographical maps of the cumulative scalp electrical field disregarding polarity (Lehmann et al. 2010). Isopotential lines reveal four major stable maps of microstates that accommodate almost three-quarters of the variance in voltage fluctuations (Figure 2a). These four patterns are remarkably consistent across ontogeny and vary primarily in their durations and proportions (Koenig et al. 2002) and may reflect a type of information patterning or processing (Lehmann et al. 2010).

The microstates were extracted from eye blink artifact free EEG records taken from the 19 channel EEG during the reading and analyzed according to Koenig et al’s (2002) procedures. The characteristics of the microstates during SH’s rest states and IS were mapped. The durations and numbers of specific states per unit time during his “readings” of the 40 photographs were correlated with the measures of accuracy noted in the previous section. Factor analyses (varimax rotation) were also completed between the different microstate measures and the proportional and relative accuracy score measures.

2.2.4. Temporal Discrimination (“Sense of Now”)

The sense of now can be defined as the minimum amount of time required to discriminate between two discrete stimuli. Previous results from our lab have identified that this minimum time required is about 28 ms based on the following procedures (Dotta et al., in submission). To discern if SH’s temporal discrimination of “now” was different, he was instructed to identify which of two red circles appeared first on a laptop computer screen. The two circles each had a diameter of 1cm and separated by a distance of 5cm on the screen. The circles were randomly presented with respect to both place presentation (left first, right first) and temporal presentation (order of duration segments). SH completed this paradigm while he sat in a comfortable chair in a dimly lit acoustic chamber (the same chamber in which he interpreted the photographs of 2.2.2). The duration of delay between the two symbols ranged from 5 to 40 msec (5 blocks of 19 trials). The time at which he displayed 100% accuracy for discrimination between two circles was considered his threshold for “now”.

2.2.5. EEG Responses of Subjects Proximal to Harribance

Historically, the proportion of accuracy of information about others has been considered greatest when SH was sitting within about 1 to 2 m of the person. We reasoned that if the source of the information originated from the space occupied by the participants, specific changes in their brain activity as inferred by QEEG may occur when SH was displaying the IS compared to baseline or other conditions. On separate days, the QEEGs of three different individuals (Male, N=3, mean age 24 SD 0.5) (not involved with part 2.2.2) were recorded while SH's EEG was being measured and he was interpreting their photographs. Each of the individuals and SH had 20, 2 second artifact free segments extracted for analysis of coherence. The subjects were assessed using the 8 channel EEG system while SH was assessed using the 19 channel system. Synchronization of EEG records were completed through 3 stages; 1) both computers were updated through Windows XP's synchronized internet time server every 1 hour. Any record taken was given a digital time stamp; 2) throughout the records stopwatches were concurrently synchronized to the same international time stamp and were used to further synchronize events within the record; 3) Each interpretation session had digital audio recording which was also time stamped and was used to transcribe the events and the associated timeline.

2.2.6. Photon Emission During the Interpretational State

To discern if changes in photon emission were occurring in the proximity of the scalp (inferred as a result of brain activity), SH sat in a comfortable chair (in a different room on two successive days) in the dark while photon emission was recorded from the right side of his head. We selected the right side on the same plane as his parietal and temporal lobes because: 1) previous research demonstrated enhanced SPECT activity in this region (Roll et al, 2002), and, 2) it was the locus of the highly consistent EEG configuration that was associated with the accuracy of the ratings for his interpretations.

A Model 15 Photometer from SRI Instruments (Pacific Photometric Instruments) with a PMT housing (BCA IP21) for a RCA electron tube (no filters) was calibrated by comparing directly to a digital luxmeter at higher intensities (> 1 lux) and by measuring the response to a 700 nm LED at 10 mA (5 millicandella; 2 millilumens/45 degree) at various distances for intensities of less than 1 lux. Lux was transformed to Watts/m^2 . The output was transformed to mV (millivolt meter) and sent to an IBM ThinkPad laptop (Windows 95) where samples were taken 3 times/s during the experimental periods. Calibration indicated that a change of 1 unit at this sensitivity was equivalent to about $5 \times 10^{-11} \text{ W/m}^2$ or a total energy of about $1.5 \times 10^{-11} \text{ J/s}$ at this distance.

2.2.7. Proximal Changes in the Geomagnetic Field Intensity

The changes in intensity (in nanoTesla) within the earth's magnetic field in the three spatial planes surrounding SH's head were measured. Routine measurements in our laboratory as well as others have revealed that the semiconductive properties of the human mass can alter the shape and intensity of the geomagnetic field along the boundaries of the body (Presman 1970). We suspected that such changes may occur when he was engaging quietly in the IS compared to rest conditions. SH completed his IS while maintaining silence to eliminate any resultant activity with respect to movement.

To measure possible left vs right hemispheric differences and how they might affect the immediately adjacent magnetic field, simultaneous measurements were taken over the left and right parietal region of the skull by placing the magnetometer sensors over each side. To discern changes in the earth's magnetic field proximal to the right side of SH's head, the two separate MEDA FVM-400 magnetometers were placed on narrow aluminum frames so the sensors would be located on the same plane as his right temporoparietal region at distances of 25 cm and 1 m. The magnetometers' outputs (X,Y,Z) were recorded by IBM laptops. Sampling (17.4 samples/s) durations were 30 sec by MEDA software through an IBM ThinkPad laptop. To compare the effects of movement artifacts, SH was instructed to move his right arm quickly and to point upwards. These conspicuous artifacts, which were qualitatively different from the distinct changes that occurred when he was sitting quietly and engaging in the IS, displayed the usual noisy oscillatory excursions with a maximum change between 100 and 200 nT.

2.3 Statistical Analyses

All analyses, including correlations (Pearson and Spearman), factor analyses, and multiple regression were completed by SPSS software.

3. Results

3.1. Quantitative Electroencephalography (QEEG)

The most unique characteristic of SH's brain activity was brief (a few seconds) high frequency (gamma range, i.e., 30 to 40 Hz) consistent configurations over the right rostral-parietal-temporal (C4,T4) and the right central and orbital frontal region (Figure 1a) while he was "calling the angel"; other areas showed slower (irregular 8 to 15 Hz) state-expected activity. When the pattern was corrected for talking (calling of the angel only) (Figure 1b), the configuration was specific to the right frontal (F4,F8), central (C4) and temporal (T4) locations, particularly around 20 Hz for F8 and T4. sLORETA software (Figure 1d, 1e) showed enhanced activity that extended into the insula and temporal cortices in the right hemisphere when compared to his resting baseline ($p < 0.001$). This pattern defined the Harribance Configuration (HC).

The HC occurred reliably for a total of about 20 s per min and with an average of 6 separate episodes when he was interpreting people or photographs but not when he engaged in other activity such as resting, meditating, or spontaneous talking about ongoing events. During interpretations SH reported he sensed a "sentient presence" to which he attributed his "information" about the participant or associated photographs. He reported he could control this "presence", even when he was not talking, which has been subjectively apparent since early childhood. Fourier analyses of the power output ($\mu V^2/Hz$) of his brain during his interpretations were associated with increases in all lobes within the delta (1 to 4 Hz) and theta (4 to 8 Hz) range upon which the HC was superimposed (Figure 1f). The increases in power within the delta and theta band were most apparent over his right temporal lobe.

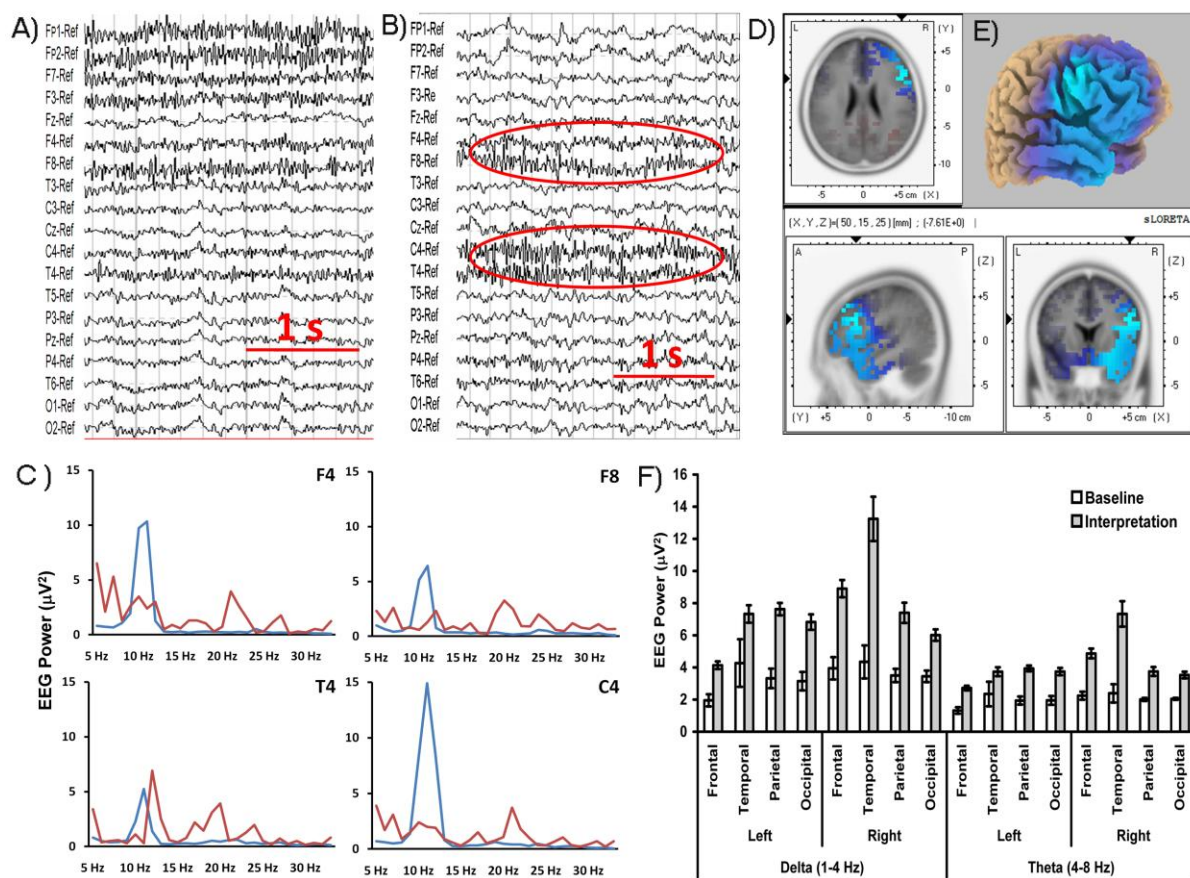


Figure 1. Samples of electroencephalographic patterns and software representations of the "Harribance configuration" (HC) during his interpretations. (a) Electronic monopolar recordings from 19 channel EEG while SH was interpreting a subjects photograph (b) Electronic monopolar recordings from 19 channel EEG while SH was in the IS but not talking (HC indicated by elliptical regions). (c) Power spectra (blue while talking, red without talking during the "interpretational state", IS) showing major enhancements within the right frontocentral and temporal lobes at approximately 20 Hz. (d) s-LORETA profile showing specific activation within the gamma band (light blue) during the HC within primarily the right temporal-insular region. (e) s-LORETA profile of major activation within the gamma band (blue) during the IS (while talking). (f) General increase in power within the delta and theta ranges during the HC compared to baseline for major areas over both hemispheres. Note the particular enhancement over the right temporal lobe.

3.2. Rated Accuracy of Types of Interpretations and EEG Patterns

Raters ranked all comments for each picture individually during the approximately 1 min interpretation (total comments $M=18$, $SD=4.7$) according to five categories. The categories and proportions (means with standard deviations in parenthesis) for the 40 photographs were: false

7(10) %, generally true 42(19) %, specifically true 25(18) %, (generally true and specifically true were summed as true 67(20) %), don't know 9(9) % and future reference 18(15) %. The correlation between the relative accuracy for his comments for the photographs and the numbers of HCs was $r = 0.46$ ($p < 0.001$). The magnitude of the association between the numbers of HCs and the proportion of true statements was similar. The raters were blind with respect to the measures of the HC for each photograph.

Factor analysis (loading coefficients in parentheses) of the total number of false (-0.02), true (0.80), don't know (-0.52), future (-0.58) and relative numbers of HCs (0.74) indicated that only HCs and true ratings shared the same positive variance and explained 37% (Eigenvalue = 1.89) of the variance. Factor analyses (all after varimax rotation) showed similar loadings when the relative duration of HCs (total duration of HCs/total time of trial) was substituted for the relative number of HCs and for relative true (0.78), relative false (-0.15), total statements (0.11), relative number HCs (0.76) and relative duration of HCs (0.71) were included. Multiple regression analyses with each of the 1 Hz increments of power showed that both the duration of the HC (Table 1) and rated accuracy (Table 2) could be predicted by specific bands over the right frontal, central, and rostral temporal regions.

Table 1. Step-wise multiple regression of the duration of HCs (dependent variable) during 40, 1 min samples while SH was interpreting for all frequency bands (1 Hz to 40 Hz) within F4, F8, C4, and T4

Variable	R	R ²	ΔR^2	B	Beta
F4 27 Hz	0.76	0.58	0.58	9.27	0.62
C4 16 Hz	0.85	0.72	0.16	-19.28	-0.30
F8 21 Hz	0.87	0.76	0.04	- 4.59	-0.32
T4 12 Hz	0.89	0.80	0.04	11.03	0.18
F4 26 Hz	0.91	0.83	0.03	4.96	0.30
Constant				14.55	

Table 2. Step-wise multiple regression of the relative accuracy scores (dependent variable) during 40, 1 min samples while SH was interpreting for all frequency bands (1 Hz to 40 Hz) within F4, F8, C4, and T4

Variable	R	R ²	ΔR^2	B	Beta
T4 17 Hz	0.32	0.11	0.11	0.20	0.40
C4 33 Hz	0.60	0.36	0.25	-1.15	-0.70
T4 19 Hz	0.66	0.44	0.11	0.16	0.40
Constant				0.86	

3.3. Microstates and Accuracy Correlations

As shown in Figure 2a, during resting (eyes closed) the structure of SH's fundamental microstates did not differ appreciably from the normative data (Koenig et al, 2002); however, the duration of each of his states was conspicuously (about half) shorter (occurrence equivalent to about 7 Hz, rather than 3 to 4 Hz). During the IS or while he was interpreting photographs different states emerged that have not been reported in the literature (Figure 2b). Class A (red) and to some extent

Class D (yellow) showed the same polarity in both cerebral hemispheres while Class B (green) and Class C (blue) showed the more typical but restricted bipolarity but within the same (right) hemisphere. The occurrence (expressed as Hz) for these states were consistent over the quartiles of the 60 sec interpretations. During his viewing of the 40 pictures the proportions of time covered by each of the four anomalous microstates were: 25(13) %, 32(11) %, 18(17) % and 25(7) %, respectively.

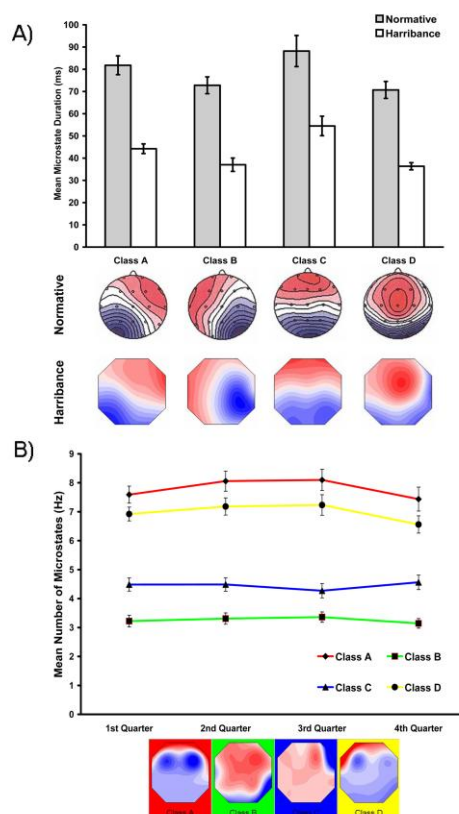


Figure 2. (a) Mean durations and SEMs (vertical bars) for each of the 4 classes of cerebral microstates for the normative sample and for SH. The topographic maps (looking down from the top with the person facing the top of the page) showed microstates when he was not engaging in interpretation that were similar to normative data. Red and blue indicate areas of opposite polarity. Normative maps adapted from reference (Koenig et al. 2002). (b) The frequency (inverse of duration) of each of the four anomalous cerebral microstates that emerged during the IS. Means and SEMs, based on 40 samples, are given for each state and are indicated by lines of the same color as the rectangle surrounding the maps. The four classes of microstates explained 54.58% (SD 10.46) of the variance in the analyzed epochs.

Factor analyses of the 40 scores for the pictures with the proportion of time for each state, the occurrence of the HC, and relative accuracy, revealed a factor (Eigenvalue = 2.16) loaded by class C (opposite polarity over right prefrontal and right temporoparietal lobes: 0.67), Class A (-0.79), the HC duration (0.82) and the relative accuracy rating (0.62). The most unusual microstate, the one

associated with the same polarity in both hemispheres (Class A), was correlated (0.55) with the numbers of statements that could not be verified by the raters. The mean duration for SH's normal microstates (when he was not engaged in the IS) and the states positively associated with the raters' accuracies was about one-half that of the normal person.

3.4. Temporal Discrimination (Sense of “Now”)

SH's threshold for sense of now was not within the normal range. Whereas accuracies for normative samples of people were 100% when the discrepancies were above 28 msec, SH's most accurate scores occurred for time delays between 10 to 20 msec; above this interval (to a maximum of 40 msec) SH's accuracy was significantly less.

3.5. EEG Responses of Subjects Proximal to Harribance

All individuals displayed increases in beta and gamma activity (Figure 3a) over their temporal lobes in the presence of SH during the interpretations. The relative increase in power within this range compared to the baseline (when SH and the subject simultaneously engaged in eyes-closed relaxation) is shown in Figure 3b. In addition to the general increase in power within the right parietal and left temporal lobes of the participants, there was a conspicuous decrease in power within the 1 to 9 Hz range (with the exception of the 6 Hz to 7 Hz increment) over the right parietotemporal regions compared to these lobes in the left hemisphere.

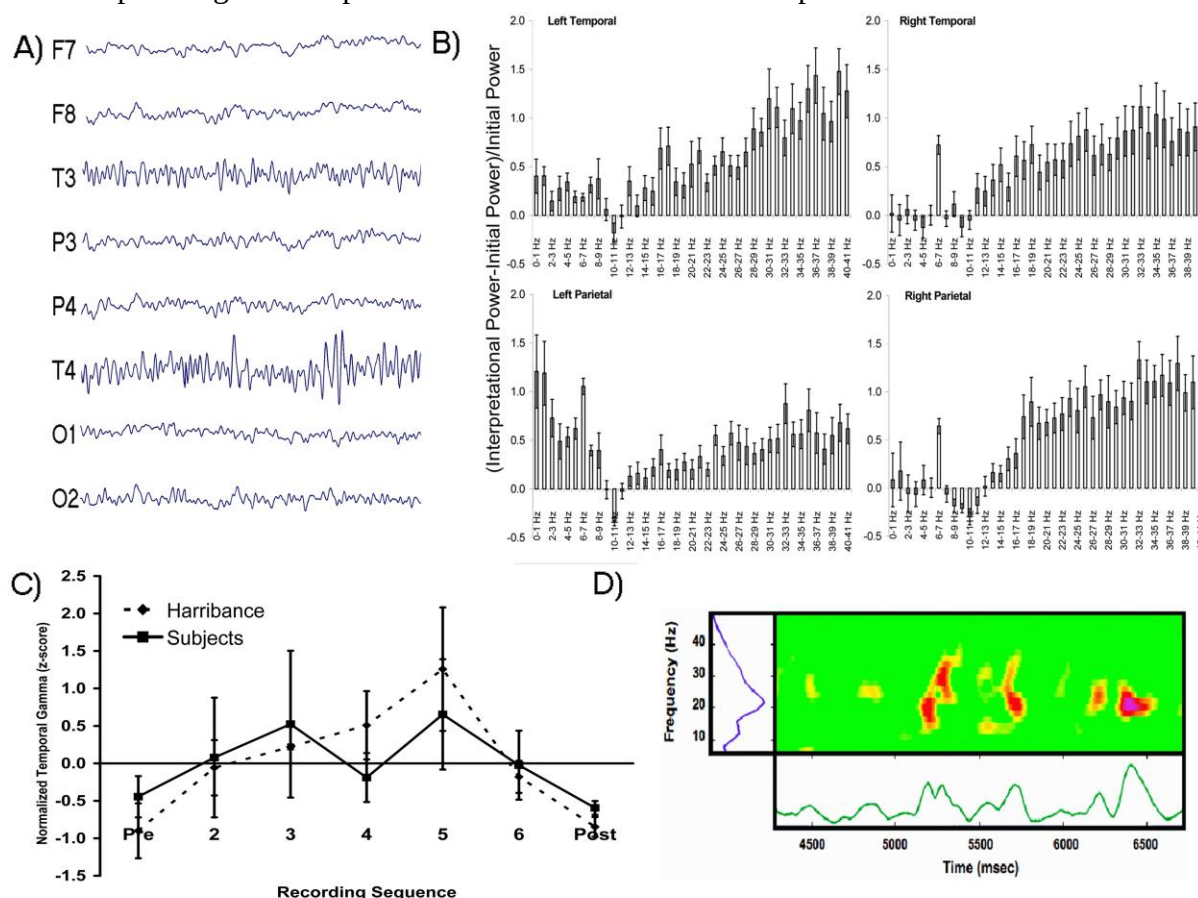


Figure 3. Responses in the brain activity of participants sitting (about 1 to 2 m) near SH while he was interpreting their photographs. (a) Typical EEG patterns of a participant while SH was interpreting their photographs. Note the higher frequency and amplitude of activity over the left (T3) and particularly the right (T4) temporal lobes. (b) Average relative change in power within each 1 Hz increment of brain activity between 1 Hz and 41 Hz for four participants during SH's interpretation relative to baseline. Note the marked decrease in power (< 10 Hz) within the right temporoparietal region except for the 6-7 Hz band within the participants' records when SH was engaged in the IS. (c) Averaged power outputs for SH and participants within the gamma range (temporal lobe) during SH's pre-IS, IS, and post-IS for the 40 photographs. Vertical bars indicate SEMs. (d) Cross-spectral analyses of power (yellow=mild coherence; red= maximum coherence) within the left temporal lobe of a sample subject and SH's right temporal lobe within various frequency intervals over time (milliseconds).

There was increased similarity of the EEG patterns for SH and the subjects over the temporal lobes (average of left and right) in particular. During the pre-IS, IS, and post-IS periods the relative power of the two brains did not differ significantly within the gamma range (Figure 3c); this was not evident for delta, theta, low-alpha, high alpha or beta bands. The increased power within the 33 to 35 Hz range over the temporal lobes of SH and the participants was conspicuous even though the latter talked rarely. Cross spectral analyses of the raw data (20, 2 sec samples per participant) indicated increased coherence within a narrower 19 to 20 Hz band as well as the wider 30 to 40 Hz band within SH's right temporal lobe and the participants' left temporal lobes during his interpretations (Figure 3d). A similar coherence occurred between SH's left and right temporal lobes. The means and standard deviations for the duration of the coherence were $M = 137$ msec and $SD = 55$ msec (or about 7 Hz) while these values for the inter-event intervals were 587 (475) msec.

3.6. Photon Emission During the Interpretational State

As can be seen in Figure 4a, the energy density (Watts/m^2) as measured by a photomultiplier tube at 0.15 m along the right side of SH's head while he sat in a comfortable chair in complete darkness, showed an increase of about 1 unit of average transmittance during the IS compared to resting baselines. The changes were reversible (Figure 4b), replicable on two separate days (Figure 4c) and controllable by the experimenters' instructions for SH to start or stop the IS. The latencies between the instruction for SH to begin the IS and the increases in transmittance were between 10 and 20 sec. Spectral analyses indicated that microvariations associated with these shifts displayed primary power peaks according to Fourier analyses between 0.2 and 0.4 Hz. Calibration indicated that a change of 1 unit at this sensitivity was equivalent to about $5 \times 10^{-11} \text{ W/m}^2$ or a total energy of about $1.5 \times 10^{-11} \text{ J/s}$ at this distance.

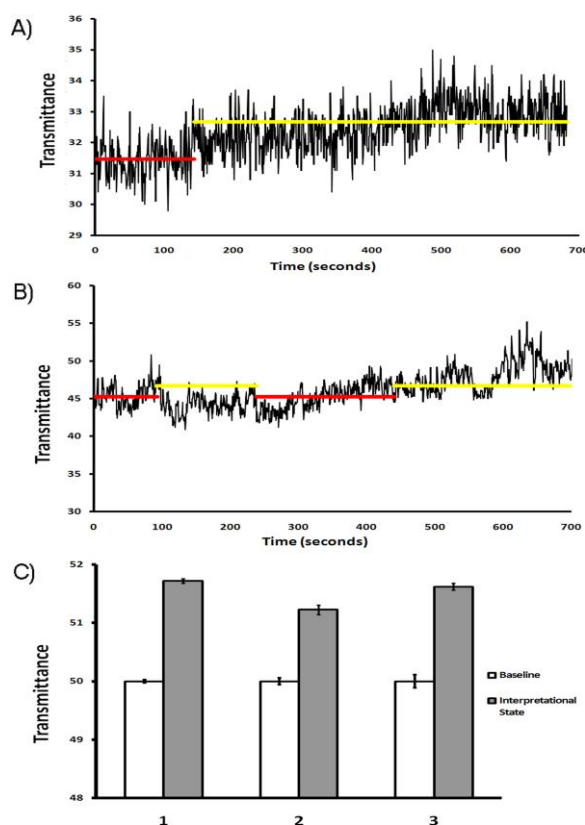


Figure 4. Photomultiplier tube measurements demonstrating an increase of approximately 1 unit of photon emission (“transmittance”) during IS. (a) Example of the increase of approximately 1 transmittance unit (yellow vs red) about 10^{-11} J/s at 0.15 m from SH’s right hemisphere when engaged in the IS (yellow line) after baseline (red). (b) Example of the reversibility of power density when SH stopped (red line) and initiated (yellow line) the IS. (c) Means and SEMs for the changes in photon detection between baseline (resting) and after initiation of the IS for three separate experiments.

3.7. Proximal Changes in the Geomagnetic Field Intensity

The steady-state (static) geomagnetic field in the horizontal plane was about 2,000 nT less over SH’s right temporoparietal region compared to his left. This was similar to what was measured about ten years ago when he visited the laboratory. During the IS (Figure 5a-c) there were relatively sudden changes in the intensity of the local geomagnetic field within 1 cm of skull. They began about 10 to 20 sec after the instructions to begin the IS. The typical magnitude of these changes was about 150 nT. According to the classic equation: $J = (B^2/2\pi\mu)$ multiplied by the volume (of his cerebrum), the energy available in this change in the geomagnetic field during the IS would be about 10^{-11} J.

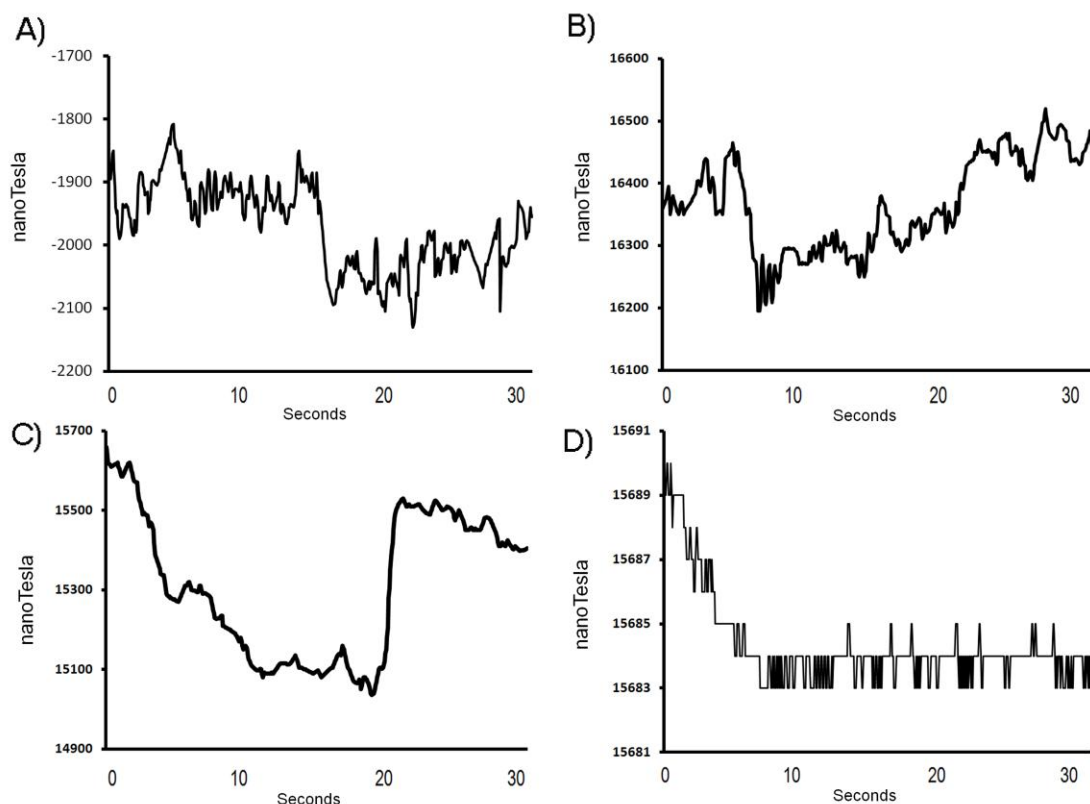


Figure 5. Changes (in nanoTesla) in the intensity of the earth's magnetic field (showing sample X,Y,Z components, measured in nanoTesla) around SH for his right temporoparietal region (a-c, at 1 cm; D=1 m). (a) Change (in nT) in geomagnetic intensity (horizontal plane in direction of magnetometer) 1 cm from the right side of SH's head about 15 s after instruction for IS. (b) Change in nT beginning about 15 s after instruction showing decrease and recovery. (c) Changes in intensity beginning at the onset of the IS effect and recovery when IS stops after about 20 s. (d) Decrease in intensity (horizontal plane) at 1 m during onset of IS. The spiky transients reflect the resolution (1 nT) of the instruments.

In the second set of experiments when the IS was engaged and the geomagnetic field was measured at 0.25 and 1 m from the right side of his head there were clear decreases of about 15 nT and 5 nT (Figure 5d), respectively, during the state compared to when he was instructed to relax. The energy change, according to the expanding volume determined by the distance, would remain equivalent to about 10^{-11} Joules. Fourier analyses indicated intrinsic amplitude modulations during these shifts that peaked within the 0.2 Hz to 0.6 Hz range.

4. Discussion

SH attributes his interpretations and intuitions to information from a sensed presence. Variants of a sensed presence have included the ancient Greek's Muses (Persinger and Makarec, 1992), mystical or religious "spirit guides" (Evans 1984) and even the concept of the "hidden observer" following hypnosis (Harrington 1995). The latter has been hypothesized to allow experients to solve complex problems even though they cannot recall the source of the solutions. These experiences have strong associations with right hemispheric processes, creativity and intuition (Chavez-Eakle et al. 2007; Jung Beeman et al. 2004). It is important to emphasize that all of these "complex" behaviors are derived from specific patterns of brain activity.

Our results indicate that reliable, measurable changes in the brain activity within the right parietotemporal region of SH occurred when he was interpreting another person or a photograph. These changes were consistent while engaging in the IS and without a talking artifact present. This is the same area that had displayed marked uptake in tracer during SPECT (Roll et al. 2002) which is not susceptible to the muscle artifacts. Given the sLORETA profile of enhanced activity within the right medial temporal, parietotemporal and insula regions (Figure 1d), we suggest that SH's ability is a variant of the process that contributes to normal intuition. It has been associated with the acquisition of information regarding past, present and future events that involve complex inferencing about which the experient is allegedly unaware. We suggest that individuals like SH are at the opposite end of the spectrum compared to Asperger's Syndrome (Senju et al, 2009) for the capacity to engage in Theory of Mind. Whereas the former display "mind-blindness", Mr. Harribance may display a "hypermentality" that may allow sensitivity to information and environmental cues not typically accessible by the normal person.

The shared variance between the ratings of the relative accuracy of the 40 photographs and the numbers of HCs during the interpretation of each photograph further validates the relationship between the EEG and SH's experience. The convergence suggests a third factor may be associated with SH's brain activity and the accuracy of information stated for each photograph. To understand what alteration in his consciousness might be occurring, the HC was analyzed for microstates of integrated cerebral activity (Koenig et al. 2002). If we assume that the neuroelectromagnetic correlates of consciousness are related systematically to the manner in which the billions of potential events (Norretranders 1998) penetrating the brain are detected (become stimuli) and are integrated into experiences, alterations in these functions might allow access to information not available in normal states.

The alteration in what is likely to be SH's sense of "now" suggests a different temporal processing or integration of sensory stimuli not typically seen in the average person. SH could discriminate latencies in the differential serial onset of two stimuli at durations between 10 and 20 msec where the average person requires more than 28 msec with this paradigm. This "doubled" processing rate was also reflected in the net durations of his microstates. The coherence was equivalent to about 7 Hz which was similar to the value for coherence between SH's left and right temporal lobes.

In addition to the normal microstates, SH also displayed patterns that have not been previously

reported. The "double (same) polarity" pattern (Class A) between the two hemispheres might be interpreted as a brief period of marked intercalation or "integrated state". Our hypothesis (Booth et al, 2005; Persinger, 1993) has been that such transient interactions allow conscious access to primarily right hemispheric information that is then transformed to linguistic equivalents or images (Persinger et al, 2002). We will be exploring the possibility that the correlations observed in this study between the non-rateable comments and the "double polarity" pattern may have contained information that was not accessible to the rater but may be accurate according to the first-person experience of the person within the photographs.

That there were congruent changes in power within the 33 to 35 Hz range over the temporal lobes of SH and the participants in the presence of SH offers an alternative explanation to the long history of belief that individuals with SH's capacity are accessing the cognitive processes of distant or deceased individuals. The experiences and memories of the participant or experient is the primary reference by which the statements about others are verified. One interpretation of the increased coherence between the 19 to 20 Hz band and 30 to 40 Hz band over SH's right temporal lobe and the participants' left temporal lobes during his interpretations would be an as yet unspecified direct access to the information within the participants' cerebral space. A more parsimonious explanation would involve a variant of enhanced suggestibility by his proximity.

If the former explanation is valid, then SH's discernment of this information would involve physical mechanisms. We examined this possibility in two ways. We measured the quantitative increase in photon emission from the right side but not the left side of his brain during his IS. University students tested in our laboratory also show increased photon emission over the right hemisphere but not over the left when they imagine light. SH's values were 4 times higher (about 6 standard deviations above the mean). We also measured the changes in the static component of the geomagnetic field around the right side of his skull. The approximately 2,000 nT reduction in the static intensity of the geomagnetic field along the right side of his skull at the level of the temporoparietal lobe compared to the left would be consistent with greater penetration of flux lines within the skull and presumably his cerebral space.

We suggest such penetration into SH's right temporoparietal region would allow cerebral access to potential information that might be contained in a yet to be specified format within the geomagnetic field (Persinger, 2008). The increment of energy associated with this access would be in the order of 10^{-11} J. This quantum of energy was emitted from the right side of his brain during the IS. In addition 10^{-11} J was the equivalent energy associated with the changes in geomagnetic intensity within the volume of space 25 cm and 100 cm from his skull. The increases in photon emission and decreases in geomagnetic intensity were matched for magnitude of energy, latency to be displayed and superimposed amplitude variation (between 0.2 Hz to 0.6 Hz). The convergence of values does not prove information was transferred from the environment but does support the first law of thermodynamics (conservation of energy), that energy is neither created nor destroyed but changes form, which may be relevant to the Harribance phenomena.

The value of approximately 10^{-11} Watts (J/s) is also well within the range generated by the electromagnetic component of brain activity. The influence of a single action potential's net change of 1.2×10^{-1} V (120 mV) upon a single charge of 1.6×10^{-19} A s is about 2×10^{-20} J (Persinger et al,

2008). The value of 10^{-11} J would be equivalent to about 10^9 action potentials or 1 billion neurons displaying one action potential per sec. Assuming an average frequency of about 10 Hz per neuron, this would involve in the order of 100 million cortical neurons. This value is well within the range estimated to be activated within the temporoparietal cortices.

5. Conclusion

We suggest that the unique organization of Sean Harribance's brain has allowed apparent access to information from others' memories. His accuracy has been sufficient to maintain his employment and be accessed by multiple private and government agencies. Quantitative EEG analyses indicated a fixed pattern of reliable increases in power over portions of the right hemisphere. The total numbers and durations of this configuration were significantly correlated with rated accuracies of information of people within photographs. SH displayed microstates that included normal as well as unique patterns whose durations were about half the values obtained for the average person.

The actual stimuli that became the information experienced by SH during his interpretations are not clear. The marked coherence of cerebral activity between SH and the participants during his close proximity and display of the IS indicates that a component of the information may originate from within the brains of the participants or a third factor shared by both. The discrete changes in photons concomitant with alterations in the intensity in the surrounding geomagnetic field in the vicinity of SH and the participants indicate involvement of physical mechanisms worthy of thorough exploration. In conclusion there is evidence that Sean Harribance intuitively verifiable information about the history and status of others and that the processes are: 1) associated with discrete patterns of his brain activity, and, 2) consistent with the current understanding of the "Theory of Mind".

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